

TITLE OF THE INVENTION  
**INTEGRATED DATABASE SYSTEM**

**AND**  
**METHOD FOR ACCESSING A PLURALITY OF DATABASES**

This application claims priority from Japanese Patent Application Reference No. 11-176412, filed on June 23, 1999, the entire content of which is incorporated herein by reference for all purposes.

BACKGROUND OF THE INVENTION

5       The present invention relates to the technique of efficiently accessing plural databases on a network system.

There are some cases in which plural database servers are provided on a network system. The plural database servers provide users on the network with their stored  
10   objects, and each of the database servers manages its own stored objects independently of the other database servers.

Directory databases are known which provide users on a network system with information such as the addresses of individuals or organizations on the network system. One  
15   example of such directory databases is an LDAP server which is described in "LDAP: Programming Director-Enabled Applications with Lightweight Directory Access Protocol" (MacMillan Technology Series), written by Tim Howes and Mark Smith, published by Macmillan Technical Publishing,

ISBN 1578700000.

In a case where plural independent databases are present on a network system, if a user is to access a particular object stored in a particular database server, 5 the user needs to specify the particular database and the particular object.

Before accessing the object, the user must be burdened with looking into the database server in which the object is stored.

#### SUMMARY OF THE INVENTION

10 The present invention makes it easy to access a particular object stored in a particular database server in a case where plural independent databases are present on a network system.

The present invention provides, for example, an 15 integrated database system which includes a plurality of database systems connected to one another through a network, each of the plurality of database systems managing its own stored data independently of the other database systems and accessing the stored data in accordance with an 20 access request, and an integrated database unit connected to the network.

The integrated database unit includes:

a directory database which stores a correspondence between each of the data stored in the plurality of

database systems and a database system in which each of the data is stored;

a database identifying means which identifies a database system stored in the directory database in accordance with target data of an access request issued by a user; and

a data access means which accesses the target data of the access request issued by the user, by issuing the specified database system with a request to access the target data of the access request issued by the user.

According to the integrated database system, if the integrated database unit receives an access request from a user, the integrated database unit refers to a directory database and identifies a database system in which target data of the access request is stored, and issues an access request to the database system and accesses the target data of the access request issued by the user. Accordingly, if the user only issues an access request to the integrated database unit once, the user can access data. The user can access the data without being aware of which database system stores the data.

According to the present invention, in the integrated database system, for example, each of the database systems manages each data by using a local data name which is an identifier unique to each data in the database system itself, and accepts an access to data corresponding to a

local data name, in accordance with an access request which specifies the local data name. The directory database stores, as to each of the data stored in the plurality of database systems, a correspondence with the database system in which each of the data is stored, a local data name of each of the data and a global data name which is a unique identifier for each data in all of the plurality of databases. The database identifying means receives an access request which specifies a global data name of target data of the access request from the user, and identifies a database system and a local data name which correspond to the received global data name and are stored in the directory database. The data access means issues the identified database system with an access request which specifies the identified local data name, and accesses the target data of the access request issued by the user.

As described above, according to the present invention, the integrated database unit manages the correspondences between global data names and local data names by means of a directory database, and receives a data access request from a user on the basis of a global data name and performs conversion between the global data name and a local data name, thereby accessing the database.

Accordingly, even if the same local data name occurs in each of a plurality of independent databases, the user can readily access the desired data that the user specifies

on the basis of a global data name.

### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more apparent from the following detailed description, when taken in conjunction with the accompanying drawings, in which:

5            Fig. 1 shows a configuration of a network system  
according to a preferred embodiment of the present  
invention;

Fig. 2 shows one example of the hardware configuration of each computer according to the preferred  
10 embodiment of the present invention;

Fig. 3 shows directory information according to the preferred embodiment of the present invention;

Fig. 4 shows the functional configurations of server computers according to the preferred embodiment of the present invention;

Fig. 5 shows steps of a process to be performed by each of the server computers according to the preferred embodiment of the present invention; and

Fig. 6 shows one example of a signal sequence  
20 between each part according to the preferred embodiment of  
the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

One preferred embodiment of the present invention

will be described below.

Fig. 1 shows the configuration of a network system according to the present embodiment.

Referring to Fig. 1, a console computer 101 is a  
5 computer through which an operator performs management of a system, such as monitoring of the operational status of the system. A server computer 111 is a computer for operating and monitoring the entire system, and includes a directory database 112 in which directory information is stored, and  
10 a database 113 in which information as to a server computer 111 and the like is stored as objects.

The server computer 121 includes a database 123 in which various kinds of information as to the server  
computer 121 itself as well as computers 124 and 125 are  
15 stored as objects, and the server computer 131 includes a database 133 in which various kinds of information as to the server computer 131 itself as well as computers 134 and 135 are stored as objects.

All of the computers are connected to one another by  
20 local area networks and communication lines.

The hardware configuration of each of the computers may use a general hardware configuration of an electronic computer of the type which is shown in Fig. 2 by way of example.

25 The hardware configuration may be used including a central processing unit 302, a main memory 301, a network

control unit 303 which controls the input and output of data to and from networks such as communication lines and a local area network, a disk unit 306, a disk control unit 307 which controls the input and output of the disk unit 306, a display unit 308, a display control unit 309 which controls the input and output of the display unit 308 and the like. The computers other than the console computer 101 need not necessarily include the display unit 308 and the display control unit 309.

10       The central processing unit 302 executes modules or codes which constitute a program loaded into the main memory 301 from the disk unit 306, whereby each of parts which will be described later with reference to Fig. 4 is formed on the computer as a process and each of operations 15 which will be described later is carried out. The program may be of a type which is recorded on a recording medium such as a CD-ROM and is read by a driver (not shown) and stored in the disk unit 306, or of a type which is supplied through a network and stored in the disk unit 306.

20       Each of the databases 113, 123 and 133 is a repository database made of a relational database or other object-oriented database, and stores, as objects or various kinds of information as to the corresponding computers, system information as to the corresponding computers, the 25 definitions of jobs, calendar information, the definitions of the operational schedules of jobs, the operational

histories of jobs.

The directory database 112 has the directory of each of global object names which are given to the respective objects stored in each of the databases 113, 123 and 133, so that each of the global object names becomes unique in all of the databases 113, 123 and 133. The directory database 112 stores, as the information of the directory of each of the global object names, an identifier of a computer including a database in which an object having the corresponding global object name is stored, and a local object name which is a unique identifier given to identify the object on the database in which the object is stored.

Fig. 3 shows the information of directories stored in the directory database 112.

Referring to Fig. 3, reference numeral 501 denotes the information of a directory corresponding to an object which is the calendar information of the computer 111. The information 501 includes a global object name, as "DN" 502 being an identifier of the directory, which is given to the calendar information of the computer 111 so that the calendar information is made unique on the system; an identifier, as "database" 503, which is given to the computer 111 so that the computer 111 is made unique on the network system, the computer 111 having the database 113 which stores the object which is the calendar information of the computer 111; and an identifier, as "objectname"

504, which is the identifier of this object on the database 113.

Similarly, reference numeral 511 denotes the information of a directory corresponding to an object which is the calendar information of the computer 124. The information 511 includes a global object name, as "DN" 512 being an identifier of the directory, which is given to the calendar information of the computer 124 so that the calendar information is made unique on the system; an identifier, as "database" 513, which is given to the computer 124 so that the computer 124 is made unique on the network system, the computer 124 having the database 123 which stores the object which is the calendar information of the computer 124; and an identifier, as "objectname" 514, which is the identifier of this object on the database 124.

In the present embodiment, the domain name of such a computer is used as an identifier which is described in the database of the information of the directory and is given to the computer so that the computer is made unique on the computer network system. Each of the computers can access the others on the basis of their domain names by using a well-known domain name server. The method of describing such a domain name in the information of the directory may be an arbitrary method which enables identification of the domain name. For example, dc = hitachi, dc = co, dc = jp

may be set as a base directory, and dc = host111, sd1, dc = hitachi, dc = co, dc = jp may be described as the domain name of the server computer 111.

As the global object name which is described as "DN" in the information of the directory, i.e., as a global object name given to an object which is a particular kind of information of a particular computer, the domain name of the particular computer to which an identifier indicative of the particular kind is added may be used. In this case as well, the method of describing the domain name may be an arbitrary method as far as it enables identification of the domain name.

Fig. 4 shows the internal functional configuration of each of the server computers 111, 121 and 131.

Since the internal functional configuration of each of the server computers 121 and 131 may be the same, Fig. 4 shows the internal functional configurations of the server computers 111 and 121 with the server computer 131 omitted.

As shown, the server computer 111 has a repository API (Application Program Interface) unit 201, a repository control unit 202, a directory database control unit 203, a database control unit 205, a database client unit 206, a remote access unit 207, and a database server unit 208.

The server computer 121 has a database server unit 210.

The operation of the system will be described below

with reference to the steps of the process shown in Fig. 5 and the signal sequence between each of the parts in the process shown in Fig. 6.

If an operator specifies the global object name of an object which is the calendar information of the computer 124 and instructs to acquire the object to the console computer 101, the console computer 101 requests the server computer 111 to acquire the object with the global object name.

10 In the server computer 111, the repository control unit 202 receives this request from the console computer 101 through the repository API unit 201 (Step 401).

If the repository control unit 202 has previously acquired the directory information of the directory of the same global object name and has cached the information, the repository control unit 202 transfers the process to Step 407 (Step 402). However, if the storage location of the object has not yet been known, the repository control unit 202 causes the process to proceed to Step 403.

20 If the repository control unit 202 can cope with the request by using the information of the directory database 112 (for example, the request is to make an inquiry about the directory information of the object), the repository control unit 202 transfers the process to Step 421 (Step 403). However, in Step 403, if the request is to acquire the object, the repository control unit 202 cannot cope

with the request by using the information of the directory database 112, and causes the process to proceed to Step 404.

5 The repository control unit 202 inquires of the directory database control unit 203 as to the directory information of the object having the global object name which the repository control unit 202 has been requested to acquire (Step 404).

10 The directory database control unit 203 inquires of the directory database 112 as to the directory information of the global object name, and the directory database 112 returns directory information corresponding to the inquired global object name to the directory database control unit 203 (Step 405). This directory information includes, in  
15 accordance with the directory information shown in Fig. 3, the domain name (described as "database" in Fig. 3) of the server computer 121 having the database 123 on which the object of the specified global object name is present, and the object name (described as "objectname" in Fig. 3) on  
20 the database 123.

When receiving the information, the directory database control unit 203 returns this information to the repository control unit 202 (Step 406).

25 The repository control unit 202 to which the information has been returned caches this information in its internal cache, and issues the database control unit

205 with the information returned from the directory database control unit 203 and a request to acquire the object (Step 407).

5 The database control unit 205 determines whether the "DN" of the computer issued together with the request to acquire the object is the domain name of the server computer 111, and issues the database client unit 206 with the information issued together with the acquirement request and a request to acquire the object (Step 408).

10 The database client unit 206 specifies the object name issued together with the request to acquire the object, and issues a request to acquire the object to the database server unit of a computer having the computer's domain name issued together with the request to acquire the  
15 object. At this time, the database client unit 206 accesses a different computer by using the remote access unit 207 (Step 409).

In this case, since the computer 121 is a different computer as viewed from the computer 111, the database  
20 client unit 206 issues the request to acquire the object to the database server unit 210 included in the server computer 121.

The database server unit 210 accesses the database 123 and acquires the object corresponding to the object  
25 name issued together with the request to acquire the object, and returns the object to the database client unit.

206 of the computer 111 which has issued the request to acquire the object (Step 410).

If the database server unit 208 of the computer 111 receives a request to acquire an object, from the database client unit 206 of the same computer 111, the database server unit 208 similarly accesses the database 113 and acquires the object having the object name issued together with the request to acquire the object, and returns the object to the database client unit 206 of the computer 111 which has issued the request to acquire the object.

The database client unit 206 to which the object has been returned from the database server unit 208 returns the object to the database control unit 205 (Step 411).

The database control unit 205 returns the object to the repository control unit 202 (Step 412). The repository control unit 202 returns the object to the repository API unit 201 (Step 413).

The repository API unit 201 returns the object to the console computer 101, and the console computer 101 presents the acquired object to the operator.

If the operator is to acquire the calendar information of the computer 124 again after the above-described process, since the directory information of the object corresponding to the calendar information of the computer 124 has been cached in the previous process, the decision condition at Step 402 is YES. Accordingly, the

repository control unit 202 omits Steps 403, 404, 405 and 406 and transfers the process to Step 407. Owing to this procedure, since it becomes unnecessary to access a directory database every time, it is possible to improve  
5 the overall processing speed.

In the above-described process, if the operator merely desires to know the directory information of an object corresponding to the information of the computer 124, the process transfers to Step 421 according to a  
10 conditional branch in Step 403. In Step 421, the repository control unit 202 instructs the directory database control unit 203 to check the information of the directory. Then, the directory database control unit 203 acquires the information of the directory from the  
15 directory database 112 (Step 422). Then, the directory database control unit 203 returns the acquired data to the repository control unit 202 (Step 423). The repository API unit 201 returns the information of the directory to the console computer 101, and the console computer 101 presents  
20 the acquired information of the directory to the operator.

In the above-described configuration, each of the database server units 208 and 210 of the respective computers 111 and 121 provides an object in accordance with not only a request to acquire an object, issued from the  
25 remote access unit 207, but also a request to acquire an object corresponding to a specified object name, issued

from an arbitrary computer.

Owing to the above-described operation, the operator, if he or she only knows the global object name of an object, can access the object without knowing a database on which the object is present nor the object name on the database.

In the above-described embodiment, the server computer 111 includes the directory database 112, and performs acquirement of an object corresponding to a global object name specified by a user and transfer of the object to the user. In addition, each of the server computers 121 and 131 may include a directory database and a configuration similar to that of the server computer 111 so that each of the server computers performs acquirement of an object corresponding to a global object name specified by a user and transfer of the object to the user. In this case, a plurality of directory databases can be prepared by duplicating the contents stored in one directory database.

Although the above description of the embodiment has been made in connection with a case in which a user acquires an object by using a global object name, the present invention can be applied to various other accesses to objects, such as updating of an object by means of a global object name.

As is apparent from the foregoing description, according to the present invention, in a case where plural

